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THE COTTON WORM OR COTTON CATERPILLAR.  
(*Alabama argillacea* Hubn.).

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BY

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# United States Department of Agriculture,

## BUREAU OF ENTOMOLOGY.

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### THE COTTON WORM OR COTTON CATERPILLAR.

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#### INTRODUCTION.

The cotton worm, or cotton caterpillar, also but incorrectly called the "army worm," has been known to cotton planters in the United States since 1793. Before the invasion by the boll weevil it and the bollworm were by all odds the most destructive cotton insects in this country. During some seasons the damage by the caterpillar began as early as June and occasionally the fields were completely defoliated by the middle of July. The destructiveness of the insect and the consternation caused among cotton planters by its ravages are well described in an account published by Mr. Thomas Affleck of Washington, Miss., in the *American Agriculturist* of September 9, 1846:

The caterpillar, cotton worm, cotton moth, or chenille of the French West Indies, Guiana, etc., has utterly blighted the hopes of the cotton planter for the present year, and produced most anxious fears for the future. I have heard from the greater part of the cotton-growing region—the news is all alike—the worm has destroyed the crop. I have no idea that any considerable portion of any State will escape. \* \* \* The present year the crop is unusually backward, at least four weeks later than usual. We have but just commenced picking, usually beginning about the last week in July or the first week in August. At this moment every field within this region of country, say, south of Vicksburg, is stripped of everything but the stems, the larger branches, and a few of the first bolls, already too hard for the worms' power of mastication. The full-grown bolls not yet become hard are completely eaten out, a circumstance I have never heard of but once before, in 1825. The fields present a most melancholy appearance; looking from the bluff at Natchez across the river to those fine plantations back of Vidalia, nothing is to be seen but the brown withered skeleton of the plant.

Until about 1871 no satisfactory methods of combating the cotton caterpillar had been discovered. Many fallacious remedies, such as attracting the moths to large fires in the fields, were more or less in use, but the only ones of even the slightest value were brushing the

insects from the plants and preventing their invasion of the fields by means of ditches. Early in the seventies the whole situation was revolutionized by the discovery that the worms could be poisoned quickly and economically by the use of Paris green or other arsenical compounds. The practice of controlling the insect by these means soon became universal in the South. Planters everywhere obtained large supplies of poison each season exactly as other regular plantation supplies were procured. As soon as the defoliation began the poisons were applied. This checked the outbreak on the plantation at the beginning, whereas without the use of the arsenicals it would have spread over the entire cotton acreage. About the same time certain changes in agriculture in the South also contributed in a very decided manner to the reduction of the importance of the pest. The large cotton fields began to be broken up into smaller fields planted to a variety of crops. This system of diversification of itself prevented such great increase in the number of the worms as had taken place in previous years. These two facts together seemed to indicate for many years that the cotton worm was no longer to be feared as an important enemy of the cotton plant in the United States.

For 21 years prior to 1911 the cotton worm had not been generally abundant in the United States, although there was local damage of some severity during different years in that period. Indeed the passing of the insect had come to be considered such a settled fact that the outbreak of 1911 was as surprising to the cotton planters as to entomologists.

#### THE OUTBREAK OF 1911.

The outbreak of 1911 did not originate in the United States, but in Central or South America. The moths flew northward very early in the season and reached the neighborhood of Brownsville, in Texas, by April. By the middle of June practically all of the cotton fields in the vicinity of Brownsville that had not been protected by the use of poisons had become defoliated. The new generations of the insects flew northward and eastward during June and July. During the latter month there appears also to have been another invasion of the United States from South America. This reinvasion took the moths into the South Atlantic States, where they were soon found in very great numbers. They bred with great rapidity and spread northward and westward. In August the western and eastern invasions coalesced, and within a few weeks the insects were numerous in cotton fields throughout the belt.

Later in the season many of the moths which developed in the cotton fields of the South flew northward, where they attracted considerable attention. Millions of individuals were found in Wash-



ington, D. C., between September 19 and October 29. On September 23 they were observed at Pittsburgh, Pa., and at Philadelphia on the same date. By September 25 they were found in great numbers in New Haven, Conn., and on October 13 at Orono, Me. Large numbers of specimens were observed in September at Milwaukee, Wis., and also at Ottawa, Canada.

Many of the moths which flew northward were found upon fruits of various kinds, which they punctured for the purpose of feeding. Peaches, apples, grapes, and other fruits were attacked in this manner and fears arose among fruit growers that an important new pest had appeared.

#### POSSIBILITY OF AN OUTBREAK IN 1912.

The cotton moth is of South American origin and does not survive the winters in the United States, except when the temperatures are above the normal or when individuals obtain unusual shelter. Whether there will be an outbreak in 1912 depends upon two contingencies: First, whether any of the moths bred in 1911 succeeded in surviving the winter in this country; and, second, whether a new invasion from South America takes place.

Careful searches for the moth have been made in favorable localities in the southern part of the cotton belt during the past winter. This investigation has extended from Brownsville, Tex., to South Carolina. No live moths have been found. Mr. J. D. Mitchell, of this bureau, placed chrysalides of the moth in rearing cages at Victoria, Tex., in the fall of 1911 and found that by the end of January they were all killed by the cold. These two facts seem to indicate that all of the moths produced in the United States in 1911 failed to survive the winter.

It is extremely difficult, however, to find the moth in hibernating quarters, and the failure to find specimens is far from conclusive proof that they do not exist; but there is another consideration which bears out the conclusion that the moths bred in this country in 1911 were all killed during the winter. This is that the history of the outbreaks of the cotton worm in the United States show that the insects were all killed during winters in which the temperatures fell below the normal. The winter of 1911-12 was abnormally cold throughout the cotton belt.

Our conclusion, therefore, from all sources of information on which dependence can be placed, is that the only fear of an outbreak during 1912 is in a reinvasion of the United States from more southern localities. There is one fact which seems to indicate that there may possibly be such a reinvasion. The chronology of the outbreaks of the insect in this country from the earlier accounts shows a distinct

tendency toward the recurrence of a series of two or three seasons of abundance. Apparently the species reaches great numbers in South America and remains abundant for several years, thus giving rise to the consecutive swarms which have invaded the United States. Since the region in which this occurrence takes place is far beyond the influence of the recent cold weather in the United States, we may suppose that the past history of the insect may be repeated and that another invasion may be expected during 1912. This would seem to be especially probable in case the temperatures of the spring months should be above the normal.

We do not wish to be understood as predicting an outbreak during the present season. The facts we have noted seem to indicate that such may take place, but, on the whole, our position is that of giving a warning rather than a prediction. In order to be on the safe side it is advised that planters make the necessary preparations for fighting the worm and that they begin operations at the earliest possible moment.

#### THE COTTON CATERPILLAR AND THE BOLL WEEVIL.

In regions where the boll weevil occurs the cotton caterpillar is not an unmixed evil. On the contrary, it generally acts as a decided check against the boll weevil. The defoliation of the plants drives many of the weevils out of the field and allows the sun to destroy numerous immature stages in fallen squares on the ground. In fact, where the defoliation is complete the boll weevil receives almost as serious a setback as happens when the planter destroys the cotton stalks in the fall. It must be noted, however, that there is a point beyond which, even in boll-weevil regions, the cotton worm is not a benefit to the crop. Where the defoliation begins early in the season the plants may be prevented from maturing the bolls, and thus the damage by the one insect is merely added to that of the other.

*In regions where the boll weevil is abundant* our advice is that planters do not poison the cotton for the leaf worm, unless it becomes numerous by the time the earliest bolls are about three-fourths grown. Where the boll weevil is present but not in great numbers the poisoning should be done at a relatively early date.

#### DESCRIPTION OF THE STAGES OF THE COTTON MOTH.

*The egg.*—The egg is light green in color and contrasts with the color of the cotton leaf, so that it is easily detected by the practiced eye. The eggs are generally placed on the underside of the leaves, never in clusters. The female deposits about 500 eggs. The duration of the egg stage varies with the temperature, ranging from 3 days to more than 20.

*The larva.*—The larvæ of the cotton moth vary greatly in size and coloration, but there are certain characteristic marks that enable one to determine the species. (See fig. 1.) Early in the season the larvæ are yellowish-green and not provided with conspicuous markings. As a matter of fact, individuals without conspicuous markings may be found in the cotton fields throughout the season. The form generally seen, however, may be described as follows: Length about  $1\frac{1}{2}$  inches, upper surface with a broad brownish or perfectly black stripe. Down the center of the stripe is a fine yellowish line and similar lines bound the black area on either side. Each segment as seen from above shows four black dots, which, of course, are much more conspicuous where the dorsal black stripe is less distinct. When viewed from the side each segment shows four black dots similar to those on the dorsal surface, but somewhat smaller in size.

The larvæ feed by preference upon the cotton leaves. In cases where they are so abundant that the leaves are destroyed they feed upon the squares and bolls and even the twigs. In the case of attack on bolls only the outer surface is devoured. On this account the work of the cotton worm on bolls can be distinguished from that of the bollworm. The latter species gnaws a hole directly through the outside of the boll and feeds upon the interior.

Careful investigations have shown that the cotton worm feeds only upon the cotton plant. In many cases where attempts were made to breed it on other plants failure resulted. In one instance Mr. E. A. Schwarz succeeded in causing a larva to develop to the chrysalis stage on morning-glory (*Ipomœa* sp.). The chrysalis, however, was imperfect and failed to develop. The statement is frequently made that the cotton caterpillar feeds upon pokeweed (*Phytolacca* sp.) and other plants. Such reports are due to mistaking some other insects for the cotton pest.

When the worms are numerous and a cotton field has been defoliated they frequently travel over the ground in great numbers in search of food. This habit is the cause of the local use of the term "army worm" for the insect.

*The chrysalis or pupa.*—The cotton caterpillar transforms to the pupal stage on the cotton plant. Unlike the bollworm, it never enters the ground for this purpose. Usually it spins a crude web, using a portion of the cotton leaf for the purpose, but in many cases no web whatever is formed, and the naked pupa hangs from the cotton plant by means of a thread spun by the larva for the purpose. (See fig. 1.) The duration of the pupal stage is from one to four weeks.

*The adult.*—The adult of the cotton worm is a moth, the wings of which expand from  $1\frac{1}{8}$  to  $1\frac{1}{2}$  inches. (See fig. 1.) The general color is brownish-yellow or tawny, in many specimens showing a somewhat crimson hue. The most conspicuous feature of the upper





FIG. 1.—The cotton worm (*Alabama argillacea*): Stages and work. (Original.)

surface is a distinct black spot on the anterior wings just beyond the middle and about one-third of the distance from the anterior to the posterior margins. The front wings are also ornamented with a number of transverse zigzag lines. The most conspicuous of these are one which crosses the anterior half of the wing immediately beyond the eye spot and another which extends from just behind the eye spot to the posterior margin. In specimens which have become rubbed these transverse markings are sometimes indiscernible.

The moth is nocturnal in its habits and has remarkable powers of flight. This is shown by its crossing the Gulf of Mexico and reaching localities in the northern United States and Canada.

Unlike the great majority of moths the proboscis of this species is strengthened, so that it can puncture such substances as green pears or apples. In 1911 and various earlier years in which invasions of northern localities took place the damage to fruit in some cases was considerable.

#### PASSING THE WINTER.

Whenever the cotton worm passes the winter in the United States it is in the adult stage. In this it is unlike the bollworm and other species, which pass the winter in the pupal stage in the ground.

The question of whether the cotton moth hibernates normally in the United States is one that was discussed at great length by entomologists and planters in former years. The early records and recent observations all seem to bear out the belief that the insect is in no sense a member of the North American fauna, and that it can survive the winter in this country only when the temperatures are favorable. In fact, there is only one authentic record of the moths surviving the winter in this country. This was the winter of 1881-82, which was unusually mild. During that winter live moths were found in the vicinity of Archer, Fla., during every month of the winter up to March, and young larvæ were found at work on volunteer cotton at the end of that month.

#### CONTROL.

The control of the cotton caterpillar is not at all difficult. The methods to be described are simple and inexpensive. Consequently there is no reason why every planter should not check the damage at the beginning.

By far the best method of control is by the use of powdered arsenate of lead. This substance has several decided advantages over any other poisons that could be used. It does not injure the foliage to any extent whatever, and adheres to the leaves in spite of considerable rainfall. In both these respects it is much to be preferred to Paris green, which is likely to injure the foliage and which does not adhere to the leaves well except when mixed with flour.



Powdered arsenate of lead should be applied at the rate of about 2 pounds per acre, more or less, depending upon the size of the cotton. It is best to make the application when the leaves are moist with dew, as is generally the case early in the morning. The less wind there is the less will be the loss from the poison which drifts onto the ground. Therefore a calm time should be selected.

The earlier the application of arsenicals can be made the better it will be. The planter should not wait until extensive defoliation has taken place. A watch should be kept upon the low moist areas, where the worms invariably appear first. As soon as the destruction of the leaves becomes evident in such places the poison should be applied. By this means the outbreak may be checked, and the necessity of poisoning the total acreage on the plantation may be avoided.

After powdered arsenate of lead the best insecticide for the cotton caterpillar is Paris green. As has been indicated, however, even small amounts of this substance are likely to injure the foliage. Such injury may not become apparent until several weeks after the application. Nevertheless, the burning of the tender leaves will show eventually in the stunted condition of the plants. This difficulty may be overcome to some extent by the use of air-slaked lime and Paris green in equal parts. Whether the lime is used or not, flour should be used with the Paris green in equal parts. This will assist greatly in causing the poison to adhere to the foliage.

London purple can also be used, but it is much less valuable than Paris green on account of the frequent occurrence of free arsenic which causes burning of the foliage.

White arsenic should not be used on cotton. It will kill the caterpillars, but will burn the foliage to such an extent that it does more harm than good.

#### METHOD OF APPLYING THE POISON.

The method of application by means of sacks applied to a pole carried on horseback through the fields, which came into general use some years ago, will be found to be perfectly satisfactory. By this means a single farm hand can poison 2 rows at a time and cover about 20 acres during a day.

The apparatus for making the application is simple. A strip of hardwood 3 inches in width, 1 inch thick, and 1 foot longer than the distance between the rows should be selected. Two 1-inch holes should be bored through the stick 6 inches from either end. The sacks to contain the poison should be made of 8-ounce duck or similar material. Flour sacks will answer the purpose, but when powdered arsenate of lead is used, two thicknesses will be required on account of the extreme fineness of the poison. The sacks should measure 6

by 20 inches and should be left open on one of the long sides. The open margins are then tacked on the ends of the pole, forming a bag, which is to be filled with the poison by means of a funnel inserted in the auger hole.

Care should be taken to determine whether the right amount of poison is being applied. This can be easily done by weighing the pole and sacks before and after a known area has been treated. Unless this is done there is likely to be a waste resulting from the application of too much poison, or it may be found that the amount that is being applied is insufficient to cover the cotton. The operators should be instructed to see that the poison falls evenly upon the plants. If too much or too little is being applied the amount can be easily regulated properly by varying the amount of jarring of the pole. It is important that the sacks do not come into contact with the cotton leaves. If they do the poison will not pass through readily and it will be found that the amount applied is too small.

#### CAUTION.

Arsenate of lead and the other arsenicals to which reference has been made are violent poisons, but there is no danger in their use on cotton if a few common-sense precautions are taken. The only cases of poisoning of domestic animals known have been where stock was allowed to break into the cotton fields soon after poisoning or where some of the poison was carelessly thrown upon the grass. The only precautions that are necessary are to keep live stock out of the fields after poisoning and to avoid throwing any of the poison on vegetation that will be devoured by live stock. It is advisable in some cases to muzzle the mules upon which the riders are mounted when the application is being made.

There is practically no danger of poisoning live stock after one or two heavy rains subsequent to the application of the poison, or, in case no rain falls, after an interval of about three weeks has elapsed.

The arsenical poisons aggravate wounds or sores on man or domestic animals. Consequently all places where the skin has been broken should be covered by some means, or at any rate washed carefully after the work has been done. In order to avoid the possibility of injury to the mules, it is advisable to throw several buckets of water over them after the work is done.

#### SUMMARY.

For the control of the cotton worm the use of powdered arsenate of lead at the rate of 2 pounds per acre is advised above all other means. This substance does not need to be mixed with any other material. Paris green, if used, should be mixed with lime and flour as described.

The work of poisoning the insect should be undertaken as soon as injury becomes apparent in any portions of the fields. By this means the expense of control will be greatly reduced.

In regions where the boll weevil is abundant the planter should take care not to poison the caterpillar too early. If he does so the production will certainly be reduced. Where the weevil occurs in considerable numbers no poisoning for the caterpillar should be done, unless there is considerable ragging of the leaves before the earliest bolls are three-fourths grown.

Approved:

JAMES WILSON,

*Secretary of Agriculture.*

WASHINGTON, D. C., *April 12, 1912.*

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